



INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We make Indiana a cleaner, healthier place to live.

Frank O'Bannon
Governor

Lori F. Kaplan
Commissioner

September 8, 2003

100 North Senate Avenue
P.O. Box 6015
Indianapolis, Indiana 46206-6015
(317) 232-8603
(800) 451-6027
www.in.gov/idem

TO: Interested Parties / Applicant

RE: Fredrickson Park-City of South Bend / 141-17728-00550

FROM: Paul Dubenetzky
Chief, Permits Branch
Office of Air Quality

Notice of Decision – Approval

Please be advised that on behalf of the Commissioner of the Department of Environmental Management, I have issued a decision regarding the enclosed matter. Pursuant to 326 IAC 2, this approval was effective immediately upon submittal of the application.

If you wish to challenge this decision, IC 4-21.5-3-7 requires that you file a petition for administrative review. This petition may include a request for stay of effectiveness and must be submitted to the Office of Environmental Adjudication, ISTA Building, 150 W. Market Street, Suite 618, Indianapolis, IN 46204, **within eighteen (18) calendar days from the mailing of this notice**. The filing of a petition for administrative review is complete on the earliest of the following dates that apply to the filing:

- (1) the date the document is delivered to the Office of Environmental Adjudication (OEA);
- (2) the date of the postmark on the envelope containing the document, if the document is mailed to OEA by U.S. mail; or
- (3) The date on which the document is deposited with a private carrier, as shown by receipt issued by the carrier, if the document is sent to the OEA by private carrier.

The petition must include facts demonstrating that you are either the applicant, a person aggrieved or adversely affected by the decision or otherwise entitled to review by law. Please identify the permit, decision, or other order for which you seek review by permit number, name of the applicant, location, date of this notice and all of the following:

- (1) the name and address of the person making the request;
- (2) the interest of the person making the request;
- (3) identification of any persons represented by the person making the request;
- (4) the reasons, with particularity, for the request;
- (5) the issues, with particularity, proposed for considerations at any hearing; and
- (6) identification of the terms and conditions which, in the judgment of the person making the request, would be appropriate in the case in question to satisfy the requirements of the law governing documents of the type issued by the Commissioner.

If you have technical questions regarding the enclosed documents, please contact the Office of Air Quality, Permits Branch at (317) 233-0178. Callers from within Indiana may call toll-free at 1-800-451-6027, ext. 3-0178.

Enclosures
FNPER-AM.dot 8/11/03



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September 8, 2003

Mr. Gary A. Gilot
Fredrickson Park - City of South Bend
1316 County City Building, 227 West Jefferson Blvd.
South Bend, Indiana 46601

Re: Exempt Construction and Operation Status,
No: 141-17728-00550

Dear Mr. Gilot:

The application from Fredrickson Park - City of South Bend, received on July 22, 2003, has been reviewed. Based on the data submitted and the provisions in 326 IAC 2-1.1-3, it has been determined that the following emission units, located at South Bend Avenue and Twyckenham Drive, South Bend, Indiana, are classified as exempt from air pollution permit requirements:

- (a) One (1) landfill gas collection system, identified as LFG, constructed in 2003, and exhausting through the open flare. The existing landfill began accepting waste in 1946 and was closed in 1975. Currently, there are 268,000 tons of municipal solid waste in place.
- (b) One (1) open flare, identified as FLARE, constructed in 2003, with a maximum heat input capacity of 0.81 MMBtu per hour and a maximum flow rate of 30 scfm of landfill gas, and exhausting through stack S02.

The following conditions shall be applicable:

- (1) Pursuant to 326 IAC 5-1-2 (Opacity Limitations) except as provided in 326 IAC 5-1-3 (Temporary Alternative Opacity Limitations), opacity shall meet the following:
 - (a) Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.
 - (b) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of 15 minutes (60 readings) in a 6-hour period as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor in a six (6) hour period.

This exemption is the first air approval issued to this source.

An application or notification shall be submitted in accordance with 326 IAC 2 to the Office of Air Quality (OAQ) if the source proposes to construct new emission units, modify existing emission units, or otherwise modify the source.



Pursuant to Contract No. A305-0-00-36, IDEM, OAQ has assigned the processing of this application to Eastern Research Group, Inc., (ERG). Therefore, questions should be directed to Yu-Lien Chu, ERG, 1600 Perimeter Park Drive, Morrisville, North Carolina 27560, or call (919) 468-7871 to speak directly to Ms. Chu. Questions may also be directed to Duane Van Laningham at IDEM, OAQ, 100 North Senate Avenue, P.O. Box 6015, Indianapolis, Indiana, 46206-6015, or call (800) 451-6027, and ask for Duane Van Laningham, or extension 3-6878, or dial (317) 233-6878.

Sincerely,

Original Signed by Paul Dubenetzky
Paul Dubenetzky, Chief
Permits Branch
Office of Air Quality

ERG/YC

cc: File - St. Joseph County
St. Joseph County Health Department
Air Compliance - Rick Reynolds
Northern Regional Office
Permit Tracking - Sara Cloe
Technical Support and Modeling - Michele Boner
Compliance Branch - Karen Nowak

Indiana Department of Environmental Management Office of Air Quality

Technical Support Document (TSD) for a Exemption

Source Background and Description

Source Name: Fredrickson Park - City of South Bend
Source Location: South Bend Avenue and Twychenham Drive, South Bend, Indiana
46601
County: St. Joseph
SIC Code: 4953
Operation Permit No.: 141-17728-00550
Permit Reviewer: ERG/YC

The Office of Air Quality (OAQ) has reviewed an application from Fredrickson Park - City of South Bend relating to the construction and operation of the following emission units.

- (a) One (1) landfill gas collection system, identified as LFG, constructed in 2003, and exhausting through the open flare. The existing landfill began accepting waste in 1946 and was closed in 1975. Currently, there are 268,000 tons of municipal solid waste in place.
- (b) One (1) open flare, identified as FLARE, constructed in 2003, with a maximum heat input capacity of 0.81 MMBtu per hour and a maximum flow rate of 30 scfm of landfill gas, and exhausting through stack S02.

History

On July 22, 2003, Fredrickson Park - City of South Bend submitted an application to the OAQ requesting to install a landfill gas collection system and a 30 scfm open flare to an existing closed municipal solid waste landfill. The city would like to develop this property into a park. This existing closed landfill began accepting waste in 1946 and was closed in 1975. The waste in place is approximately 268,000 tons (243,000 Megagrams). Since this landfill was constructed before 1991 and has a capacity less than 2.5 Mg, it is not subject to the NSPS for Municipal Solid Waste Landfills (40 CFR 60, Subpart WWW), or NESHAP for Municipal Solid Waste Landfills (40 CFR 63, Subpart AAAA), and is not required to obtain a Part 70 Permit.

Existing Approvals

This exemption is the first air approval issued to this source.

Enforcement Issue

There are no enforcement actions pending.

Stack Summary

Stack ID	Operation	Height (feet)	Diameter (feet)	Flow Rate (acfm)	Temperature (°F)
02	Flare	20	0.33	30	800-1,200

Recommendation

The staff recommends to the Commissioner that the operation be approved. This recommendation is based on the following facts and conditions:

Unless otherwise stated, information used in this review was derived from the application and additional information submitted by the applicant.

An application for the purposes of this review was received on July 22, 2003.

Emission Calculations

See Appendix A of this document for detailed emissions calculations (page 1 and 2). The CH₄, CO₂, and NMOC emissions are calculated by the EPA LandGEM model and the results are attached as Appendix B. The maximum Non-Methane Organic Compound (NMOC) emissions from the expanded landfill are 2.46 Mg/yr, which occurred in 1975. The current NMOC emissions from this landfill site are 0.8 Mg/yr in 2003. According to AP-42, Chapter 4.2, the landfill gas collection efficiency for regular covered landfills is 75%. Assuming that all the NMOC are VOC, the fugitive VOC emissions from the expanded landfill can be calculated as follows:

$$0.8 \text{ Mg/yr} \times 1.1 \text{ ton/Mg} \times (1-75\%) = 0.22 \text{ tons/yr.}$$

VOC emissions from the flare are 0.02 tons/yr for a total of 0.24 tons/yr of VOC.

Potential To Emit of Source Before Controls

Pursuant to 326 IAC 2-1.1-1(16), Potential to Emit is defined as “the maximum capacity of a stationary source or emissions unit to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or type or amount of material combusted, stored, or processed shall be treated as part of its design if the limitation is enforceable by the U. S. EPA, the department, or the appropriate local air pollution control agency.”

This table reflects the PTE before controls. Control equipment is not considered federally enforceable until it has been required in a federally enforceable permit.

Pollutant	Potential To Emit (tons/year)
PM	0.09
PM-10	0.09
SO ₂	0.07
VOC	0.24
CO	1.31
NO _x	0.24

* This includes 0.22 tons/yr of fugitive VOC emissions from this landfill and 0.02 tons/yr of VOC emissions from the flare combustion.

HAP's	Potential To Emit (tons/year)
TOTAL	0.05

- (a) The potential to emit (as defined in 326 IAC 2-1.1-1(16)) of criteria pollutants is less than 100 tons per year. Therefore, the source is not subject to the provisions of 326 IAC 2-7.
- (b) The potential to emit (as defined in 326 IAC 2-1.1-1(16)) of any single HAP is less than ten (10) tons per year and/or the potential to emit (as defined in 326 IAC 2-1.1-1(16)) of a combination of HAPs is less than twenty-five (25) tons per year. Therefore, the source is not subject to the provisions of 326 IAC 2-7.
- (c) The potential to emit (as defined in 326 IAC 2-1.1-1(16)) of criteria pollutants is less than 25 tons per year. Therefore, the source is not subject to the provisions of 326 IAC 2-6.1.
- (d) The potential to emit (as defined in 326 IAC 2-1.1-1(16)) of pollutants is less than the levels listed in 326 IAC 2-5.5-1(b), therefore the source is not subject to the provisions of 326 IAC 2-5.5.1.
- (e) The potential to emit (as defined in 326 IAC 2-1.1-1(16)) of pollutants is less than the levels listed in 326 IAC 2-1.1-3(d)(1), therefore, the source is subject to the provisions of 326 IAC 2-1.1-3.
- (f) **Fugitive Emissions**
 Since this type of operation is not in one of the twenty-eight (28) listed source categories under 326 IAC 2-2 and since there are no applicable New Source Performance Standards that were in effect on August 7, 1980, the fugitive particulate matter (PM) and volatile organic compound (VOC) emissions are not counted toward determination of PSD applicability.

County Attainment Status

The source is located in St. Joseph County.

Pollutant	Status
PM-10	Attainment
SO ₂	Attainment
NO ₂	Attainment
Ozone	Maintenance Attainment
CO	Attainment
Lead	Attainment

- (a) Volatile organic compounds (VOC) are precursors for the formation of ozone. Therefore, VOC emissions are considered when evaluating the rule applicability relating to the ozone standards. St. Joseph County has been designated as attainment or unclassifiable for ozone. Therefore, VOC emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2.
- (b) St. Joseph County has been classified as attainment or unclassifiable for all other criteria pollutants. Therefore, these emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2.
- (c) **Fugitive Emissions**
 Since this type of operation is not in one of the 28 listed source categories under 326 IAC 2-2, or 326 IAC 2-3 and since there are no applicable New Source Performance Standards that were in effect on August 7, 1980, the fugitive particulate matter (PM) and volatile organic compound (VOC) emissions are not counted toward determination of PSD applicability.

Source Status

Existing Source PSD Definition (emissions after controls, based on 8,760 hours of operation per year at rated capacity and/ or as otherwise limited):

Pollutant	Emissions (ton/yr)
PM	0.09
PM10	0.09
SO ₂	0.07
VOC	0.02
CO	1.31
NO _x	0.24

- (a) This existing source is not a major stationary source because no attainment regulated pollutant is emitted at a rate of 250 tons per year or more, and it is not in one of the 28 listed source categories.
- (b) These emissions are based on the potential to emit from this source after control.

Part 70 Permit Determination

326 IAC 2-7 (Part 70 Permit Program)

This existing source, including the emissions from the new 30 cfm flare, is not subject to the Part 70 Permit requirements because the potential to emit (PTE) of:

- (a) each criteria pollutant is less than 100 tons per year,
- (b) a single hazardous air pollutant (HAP) is less than 10 tons per year, and
- (c) any combination of HAPs is less than 25 tons/year.

This status is based on all the air approvals issued to the source.

Federal Rule Applicability

- (a) There are no New Source Performance Standards (NSPS)(326 IAC 12 and 40 CFR Part 60) applicable to this woodworking operation.
- (b) The existing municipal solid waste landfill was constructed in 1945 and was closed in 1975. Therefore, the requirements of the New Source Performance Standard for Municipal Solid Waste Landfills (326 IAC 12 and 40 CFR 60.750-759, Subpart WWW) are not applicable to this source.
- (c) There are no National Emission Standards for Hazardous Air Pollutants (NESHAPs)(326 IAC 14 and 40 CFR Part 63) applicable to this source.
- (d) This existing landfill did not accept waste after November 8, 1987 and has a design capacity less than 2.5 million megagrams. Therefore, the requirements of National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Municipal Solid Waste Landfills (40 CFR 63.1930 - 63.1952, Subpart AAAA) are not applicable to this source.

State Rule Applicability - Entire Source

326 IAC 2-2 (Prevention of Significant Deterioration (PSD))

This source was constructed in 1946 and modified in 2003. This source is not in 1 of the 28 source categories and the potential to emit all criteria pollutants and PM from the existing source before and after this modification is less than two hundred and fifty (250) tons per year. Therefore, the existing source is a PSD minor source and the requirements of 326 IAC 2-2 (PSD) are not applicable.

326 IAC 2-4.1 (New Source Toxics Control)

This source was constructed in 1946 and modified in 2003 (this modification). The potential to emit HAP from this modification is less than 10 tons/yr for a single HAP and less than 25 tons/yr for any combination of HAPs. Therefore, the requirements of 326 IAC 2-4.1 (MACT) are not applicable.

326 IAC 2-6 (Emission Reporting)

This source is located in St. Joseph County and the potential to emit VOC and NO_x is each less than ten (10) tons per year. Therefore, 326 IAC 2-6 does not apply.

326 IAC 5-1 (Opacity Limitations)

Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary Alternative Opacity Limitations), opacity shall meet the following, unless otherwise stated in this permit:

- (a) Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.
- (b) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings) as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor) in a six (6) hour period.

State Rule Applicability - Landfill Gas Collection System (LFG)

326 IAC 8-8.1 (Municipal Solid Waste Landfills Not Located in Clark, Floyd, Lake, and Porter Counties)

This source is located in St. Joseph County and was closed before November 8, 1987. Therefore, this landfill is not subject to the requirements of 326 IAC 8-8.1 (Municipal Solid Waste Landfills Not Located in Clark, Floyd, Lake, and Porter Counties).

State Rule Applicability - 30 scfm Open Flare (FLARE)

326 IAC 9-1-2 (Carbon Monoxide Emission Requirements)

This source is not among the listed source categories in 326 IAC 9-1-2. Therefore, the requirements of 326 IAC 9-1-2 are not applicable to this flare.

326 IAC 10-1-3 (Nitrogen Oxide Emission Requirements)

This source is not located in Clark or Floyd County. Therefore, the requirements of 326 IAC 10-1-3 are not applicable to this flare.

Conclusion

The construction and operation of this landfill gas collection system and the 30 cfm open flare shall be subject to the conditions of the attached proposed Exemption 141-17728-00550.

Appendix A: Emission Calculations
Combustion Emissions
From the 30 scfm Open Flare

Company Name: Fredrickson Park - City of South Bend
Address: South Bend Ave. and Twyckenham Dr., South Bend, IN 46601
Exemption#: 141-17728-00550
Reviewer: ERG/YC
Date: August 11, 2003

Fuel Input
MMBtu/hr

Flow Rate
scfm

0.81

30

	Pollutant					
Emission Factor	PM ^a 177.0 (ug/dsl)	PM10 ^a 177.0 (ug/dsl)	SO ₂ ^c 49.60 (ppmv)	NOx ^b 0.07 (lbs/MMBtu)	CO ^b 0.37 (lbs/MMBtu)	NMOC ^d 557.8 (ppmv)
Potential Emission in tons/yr	0.09	0.09	0.07	0.24	1.31	0.02

^a Emission Factors are from AP-42, Chapter 13.5 - Industrial Flares -Table 13.5-1 - Soot for average smoke flare (AP-42, 01/95).

Assume PM emissions equal to PM10 emissions.

^b Emission Factors are from AP-42, Chapter 13.5 - Industrial Flares, Table 13.5-1 (AP-42, 01/95)

^c The total inlet concentration of Sulfur content compounds in AP-42, Chapter 2.4 - Municipal Solid Waste Landfills - Table 2.4-1 (AP-42, 11/98)

^d The NMOC concentration is the default value in EPA Landfill Air Emission Model, Version 2.01.

Methodology

PM/PM10 Emissions (tons/yr) = Flow Rate (scfm) x 60 (min/hr) x 28.317 (l/scf) x Emission Factor (ug/dsl) x 1g/1000000 ug x 1 lbs/454 g x 8760 (hr/yr) x 1 ton/2000 lbs

SO₂ Emissions (tons/yr) = Flow Rate (scfm) x Emission Factor (ppmv) /1000,000 x (1 atm / (Gas Constant (0.7032 atm-cf/lb mole-R) / Temp (60F+ 460)))
x Mole weight of SO₂ (64 lbs/lbs mole) x 60 min/hr x 8760 hr/yr x 1 ton/2000 lbs

NOx/CO Emissions (tons/yr) = Max. Heat Input (MMBtu/hr) x Emission Factor (lbs/MMBtu) x 8760 hr/yr x 1 ton/2000 lbs

NMOC Emissions (tons/yr) = Flow Rate (scfm) x Emission Factor (ppmv) /1000,000 x 1 atm / Gas Constant (0.7032 atm-cf/lb mole-R) / Temp (60F+ 460)
x Mole weight of Hexane (lbs/lbs mole) x 60 min/hr x 8760 hr/yr x 1 ton/2000 lbs x 75% collection efficiency x (1-98% control efficiency)

Appendix A: Emission Calculations
HAPs Emissions
From the Existing Landfill

Company Name: Fredrickson Park - City of South Bend
Address: South Bend Ave. and Twyckenham Dr., South Bend, IN 46601
Exemption#: 141-17728-00550
Reviewer: ERG/YC
Date: August 11, 2003

1. Landfill Gas (LFG) Production Rate:

3.77E+05m³/yr (= CH₄ + CO₂ production rate in 2003 from the EPA Landfill Air Emission Model - Appendix B)

2. Collection Efficiency:

75%

(AP-42, Chapter 4.2)

3. Control Efficiency:

98%

(required by NSPS)

CAS Number	Compound	*HAP Concentration (ppmv)	Molecular Weight	Uncontrolled HAPs Emissions (tons/yr)	Fugitive HAPs Emissions (tons/yr)	Captured HAPs after Control Devices (tons/yr)	Total HAP Emissions (tons/yr)
71-55-6	1,1,1-Trichloroethane (methyl chloroform)	0.48	133.41	1.17E-03	2.91E-04	1.75E-05	3.09E-04
79-34-5	1,1,2,2-Tetrachloroethane	1.11	167.85	3.39E-03	8.47E-04	5.08E-05	8.98E-04
75-34-3	1,1-Dichloroethane (ethylidene dichloride)	2.35	98.97	4.23E-03	1.06E-03	6.35E-05	1.12E-03
75-35-4	1,1-Dichloroethene (vinylidene chloride)	0.20	96.94	3.53E-04	8.82E-05	5.29E-06	9.35E-05
107-06-2	1,2-Dichloroethane (ethylene dichloride)	0.41	98.96	7.38E-04	1.85E-04	1.11E-05	1.96E-04
78-87-5	1,2-Dichloropropane (propylene dichloride)	0.18	112.99	3.70E-04	9.25E-05	5.55E-06	9.81E-05
107-13-1	Acrylonitrile	6.33	53.06	6.11E-03	1.53E-03	9.17E-05	1.62E-03
75-15-0	Carbon disulfide	0.58	76.13	8.03E-04	2.01E-04	1.20E-05	2.13E-04
56-23-5	Carbon tetrachloride	0.00	153.84	1.12E-05	2.80E-06	1.68E-07	2.97E-06
463-58-1	Carbonyl sulfide	0.49	60.07	5.35E-04	1.34E-04	8.03E-06	1.42E-04
108-90-7	Chlorobenzene	0.25	112.56	5.12E-04	1.28E-04	7.68E-06	1.36E-04
75-00-3	Chloroethane (ethyl chloride)	1.25	64.52	1.47E-03	3.67E-04	2.20E-05	3.89E-04
67-66-3	Chloroform	0.03	119.39	6.52E-05	1.63E-05	9.77E-07	1.73E-05
75-09-2	Dichloromethane (methylene chloride)	14.30	84.94	2.21E-02	5.52E-03	3.31E-04	5.86E-03
100-41-4	Ethylbenzene	4.61	106.16	8.90E-03	2.23E-03	1.34E-04	2.36E-03
110-54-3	Hexane	6.57	86.18	1.03E-02	2.58E-03	1.55E-04	2.73E-03
78-93-3	Methyl ethyl ketone	7.09	72.11	9.30E-03	2.33E-03	1.40E-04	2.46E-03
108-10-1	Methyl isobutyl ketone	1.87	100.16	3.41E-03	8.52E-04	5.11E-05	9.03E-04
127-18-4	Perchloroethylene (tetrachloroethene)	3.73	165.83	1.13E-02	2.81E-03	1.69E-04	2.98E-03
79-01-6	Trichloroethylene (trichloroethene)	2.82	131.4	6.74E-03	1.69E-03	1.01E-04	1.79E-03
75-01-4	Vinyl chloride	7.34	62.5	8.35E-03	2.09E-03	1.25E-04	2.21E-03
71-43-2	Benzene	1.91	78.11	2.71E-03	6.79E-04	4.07E-05	7.19E-04
74-87-3	Methyl chloride (Chloromethane)	1.21	50.49	1.11E-03	2.78E-04	1.67E-05	2.95E-04
108-88-3	Toluene	39.30	92.13	6.59E-02	1.65E-02	9.88E-04	1.75E-02
1330-20-7	Xylene (isomers and mixture)	12.10	106.16	2.34E-02	5.84E-03	3.51E-04	6.19E-03
	Mercury Compounds	0.000292	200.61	1.07E-06	2.66E-07	1.60E-08	2.82E-07
7647-01-0	**Hydrogen Chloride	126.4	36	-	-	1.24E-03	1.24E-03
Total Emissions				0.19	0.05	0.004	0.05

*The HAP concentrations are from AP-42, Chapter 2.4 - Municipal Solid Waste Landfills - Table 2.4-1 (AP-42, 11/98)

** Assume that the HCl concentration is the total chlorinated compound concentration in LFG. HCl only occurs in the combustion process of the control device.

Methodology

Uncontrolled HAPs Emissions (tons/yr) = LFG Production Rate (m³/yr) x 35.31 ft³/m³ x Concentration (ppmv) / 1000,000 x (1 atm / (Gas Constant (0.7032 atm-cf/lb mole-R) / Temp (60F+ 460))) x Mole weight of HAPs (lbs/lbs mole) x 1 ton/2000 lbs

Fugitive HAP Emissions = Uncontrolled HAPs Emissions (tons/yr) x (1 - Collection Efficiency)

Captured HAPs after control device = Uncontrolled HAPs Emissions (tons/yr) x Collection Efficiency x (1 - Control Efficiency)

HCl Emissions (tons/yr) = LFG Production Rate (m³/yr) x 35.31 ft³/m³ x Chlorinated Compound Concentrations (ppmv) / 1000,000 x (1 atm / ((Gas Constant (0.7032 atm-cf/lb mole-R) / Temp (60F+ 460))) x Mole weight of HCl (lbs/lbs mole) x 1 ton/2000 lbs x Collection Efficiency x (1 - Control Efficiency)

Total HAP Emissions (tons/yr) = Fugitive HAP Emissions (tons/yr) + HAPs after Control Device (tons/yr)

Appendix B - Model Output

Fredrickson Park - City of South Bend

Model Parameters

Lo : 139.60 m³ / Mg
 k : 0.0267 1/yr
 NMOC : 557.80 ppmv
 Methane : 50.0000 % volume
 Carbon Dioxide : 50.0000 % volume

Landfill Parameters

Year Opened : 1945 Current Year : 2003 Closure Year: 1975
 Capacity : 243000 Mg

Model Results

Year	Refuse In Place (Mg)	NMOC Emission Rate	
		(Mg/yr)	(Cubic m/yr)
1946	8.100E+03	1.382E-01	3.856E+01
1947	1.620E+04	2.710E-01	7.560E+01
1948	2.430E+04	3.986E-01	1.112E+02
1949	3.240E+04	5.211E-01	1.454E+02
1950	4.050E+04	6.389E-01	1.782E+02
1951	4.860E+04	7.521E-01	2.098E+02
1952	5.670E+04	8.608E-01	2.401E+02
1953	6.480E+04	9.652E-01	2.693E+02
1954	7.290E+04	1.066E+00	2.973E+02
1955	8.100E+04	1.162E+00	3.242E+02
1956	8.910E+04	1.255E+00	3.500E+02
1957	9.720E+04	1.344E+00	3.749E+02
1958	1.053E+05	1.429E+00	3.987E+02
1959	1.134E+05	1.511E+00	4.216E+02
1960	1.215E+05	1.590E+00	4.437E+02
1961	1.296E+05	1.666E+00	4.648E+02
1962	1.377E+05	1.739E+00	4.851E+02
1963	1.458E+05	1.809E+00	5.047E+02
1964	1.539E+05	1.876E+00	5.234E+02
1965	1.620E+05	1.941E+00	5.415E+02
1966	1.701E+05	2.003E+00	5.588E+02
1967	1.782E+05	2.063E+00	5.754E+02
1968	1.863E+05	2.120E+00	5.914E+02
1969	1.944E+05	2.175E+00	6.068E+02
1970	2.025E+05	2.228E+00	6.216E+02
1971	2.106E+05	2.279E+00	6.358E+02
1972	2.187E+05	2.328E+00	6.494E+02

1973	2.268E+05	2.375E+00	6.625E+02
1974	2.349E+05	2.420E+00	6.751E+02
1975	2.430E+05	2.463E+00	6.871E+02
1976	2.430E+05	2.366E+00	6.602E+02
1977	2.430E+05	2.274E+00	6.343E+02
1978	2.430E+05	2.185E+00	6.094E+02
1979	2.430E+05	2.099E+00	5.855E+02
1980	2.430E+05	2.017E+00	5.626E+02
1981	2.430E+05	1.937E+00	5.405E+02
1982	2.430E+05	1.862E+00	5.193E+02
1983	2.430E+05	1.789E+00	4.990E+02
1984	2.430E+05	1.718E+00	4.794E+02
1985	2.430E+05	1.651E+00	4.606E+02
1986	2.430E+05	1.586E+00	4.425E+02
1987	2.430E+05	1.524E+00	4.252E+02
1988	2.430E+05	1.464E+00	4.085E+02
1989	2.430E+05	1.407E+00	3.925E+02
1990	2.430E+05	1.352E+00	3.771E+02
1991	2.430E+05	1.299E+00	3.623E+02
1992	2.430E+05	1.248E+00	3.481E+02
1993	2.430E+05	1.199E+00	3.345E+02
1994	2.430E+05	1.152E+00	3.214E+02
1995	2.430E+05	1.107E+00	3.088E+02
1996	2.430E+05	1.063E+00	2.966E+02
1997	2.430E+05	1.022E+00	2.850E+02
1998	2.430E+05	9.816E-01	2.738E+02
1999	2.430E+05	9.431E-01	2.631E+02
2000	2.430E+05	9.061E-01	2.528E+02
2001	2.430E+05	8.706E-01	2.429E+02
2002	2.430E+05	8.364E-01	2.333E+02
2003	2.430E+05	8.036E-01	2.242E+02

Model Results

Year	Methane Emission Rate		
	Refuse In Place (Mg)	(Mg/yr)	(Cubic m/yr)
1946	8.100E+03	2.162E+01	3.240E+04
1947	1.620E+04	4.238E+01	6.353E+04
1948	2.430E+04	6.234E+01	9.344E+04
1949	3.240E+04	8.151E+01	1.222E+05
1950	4.050E+04	9.993E+01	1.498E+05
1951	4.860E+04	1.176E+02	1.763E+05
1952	5.670E+04	1.346E+02	2.018E+05
1953	6.480E+04	1.510E+02	2.263E+05
1954	7.290E+04	1.667E+02	2.498E+05
1955	8.100E+04	1.817E+02	2.724E+05
1956	8.910E+04	1.962E+02	2.941E+05
1957	9.720E+04	2.102E+02	3.150E+05
1958	1.053E+05	2.235E+02	3.351E+05
1959	1.134E+05	2.364E+02	3.543E+05
1960	1.215E+05	2.487E+02	3.728E+05
1961	1.296E+05	2.606E+02	3.906E+05
1962	1.377E+05	2.720E+02	4.077E+05
1963	1.458E+05	2.829E+02	4.241E+05
1964	1.539E+05	2.935E+02	4.399E+05
1965	1.620E+05	3.036E+02	4.550E+05
1966	1.701E+05	3.133E+02	4.696E+05
1967	1.782E+05	3.226E+02	4.836E+05
1968	1.863E+05	3.316E+02	4.970E+05
1969	1.944E+05	3.402E+02	5.099E+05
1970	2.025E+05	3.485E+02	5.223E+05
1971	2.106E+05	3.564E+02	5.342E+05
1972	2.187E+05	3.641E+02	5.457E+05
1973	2.268E+05	3.714E+02	5.567E+05
1974	2.349E+05	3.785E+02	5.673E+05
1975	2.430E+05	3.852E+02	5.774E+05
1976	2.430E+05	3.701E+02	5.548E+05
1977	2.430E+05	3.556E+02	5.330E+05
1978	2.430E+05	3.417E+02	5.121E+05
1979	2.430E+05	3.283E+02	4.921E+05
1980	2.430E+05	3.154E+02	4.728E+05
1981	2.430E+05	3.030E+02	4.542E+05
1982	2.430E+05	2.912E+02	4.364E+05
1983	2.430E+05	2.797E+02	4.193E+05
1984	2.430E+05	2.688E+02	4.029E+05
1985	2.430E+05	2.582E+02	3.871E+05
1986	2.430E+05	2.481E+02	3.719E+05
1987	2.430E+05	2.384E+02	3.573E+05
1988	2.430E+05	2.290E+02	3.433E+05

1989	2.430E+05	2.200E+02	3.298E+05
1990	2.430E+05	2.114E+02	3.169E+05
1991	2.430E+05	2.031E+02	3.045E+05
1992	2.430E+05	1.952E+02	2.925E+05
1993	2.430E+05	1.875E+02	2.811E+05
1994	2.430E+05	1.802E+02	2.700E+05
1995	2.430E+05	1.731E+02	2.595E+05
1996	2.430E+05	1.663E+02	2.493E+05
1997	2.430E+05	1.598E+02	2.395E+05
1998	2.430E+05	1.535E+02	2.301E+05
1999	2.430E+05	1.475E+02	2.211E+05
2000	2.430E+05	1.417E+02	2.124E+05
2001	2.430E+05	1.362E+02	2.041E+05
2002	2.430E+05	1.308E+02	1.961E+05
2003	2.430E+05	1.257E+02	1.884E+05

Model Results

Year	Carbon Dioxide Emission Rate		
	Refuse In Place (Mg)	(Mg/yr)	(Cubic m/yr)
1946	8.100E+03	5.931E+01	3.240E+04
1947	1.620E+04	1.163E+02	6.353E+04
1948	2.430E+04	1.710E+02	9.344E+04
1949	3.240E+04	2.236E+02	1.222E+05
1950	4.050E+04	2.742E+02	1.498E+05
1951	4.860E+04	3.227E+02	1.763E+05
1952	5.670E+04	3.694E+02	2.018E+05
1953	6.480E+04	4.142E+02	2.263E+05
1954	7.290E+04	4.573E+02	2.498E+05
1955	8.100E+04	4.987E+02	2.724E+05
1956	8.910E+04	5.384E+02	2.941E+05
1957	9.720E+04	5.766E+02	3.150E+05
1958	1.053E+05	6.133E+02	3.351E+05
1959	1.134E+05	6.486E+02	3.543E+05
1960	1.215E+05	6.824E+02	3.728E+05
1961	1.296E+05	7.150E+02	3.906E+05
1962	1.377E+05	7.463E+02	4.077E+05
1963	1.458E+05	7.763E+02	4.241E+05
1964	1.539E+05	8.052E+02	4.399E+05
1965	1.620E+05	8.329E+02	4.550E+05
1966	1.701E+05	8.596E+02	4.696E+05
1967	1.782E+05	8.852E+02	4.836E+05
1968	1.863E+05	9.098E+02	4.970E+05
1969	1.944E+05	9.334E+02	5.099E+05
1970	2.025E+05	9.561E+02	5.223E+05
1971	2.106E+05	9.779E+02	5.342E+05
1972	2.187E+05	9.989E+02	5.457E+05
1973	2.268E+05	1.019E+03	5.567E+05
1974	2.349E+05	1.038E+03	5.673E+05
1975	2.430E+05	1.057E+03	5.774E+05
1976	2.430E+05	1.016E+03	5.548E+05
1977	2.430E+05	9.757E+02	5.330E+05
1978	2.430E+05	9.375E+02	5.121E+05
1979	2.430E+05	9.007E+02	4.921E+05
1980	2.430E+05	8.654E+02	4.728E+05
1981	2.430E+05	8.315E+02	4.542E+05
1982	2.430E+05	7.989E+02	4.364E+05
1983	2.430E+05	7.675E+02	4.193E+05
1984	2.430E+05	7.374E+02	4.029E+05
1985	2.430E+05	7.085E+02	3.871E+05
1986	2.430E+05	6.807E+02	3.719E+05
1987	2.430E+05	6.540E+02	3.573E+05
1988	2.430E+05	6.284E+02	3.433E+05

1989	2.430E+05	6.038E+02	3.298E+05
1990	2.430E+05	5.801E+02	3.169E+05
1991	2.430E+05	5.573E+02	3.045E+05
1992	2.430E+05	5.355E+02	2.925E+05
1993	2.430E+05	5.145E+02	2.811E+05
1994	2.430E+05	4.943E+02	2.700E+05
1995	2.430E+05	4.749E+02	2.595E+05
1996	2.430E+05	4.563E+02	2.493E+05
1997	2.430E+05	4.384E+02	2.395E+05
1998	2.430E+05	4.212E+02	2.301E+05
1999	2.430E+05	4.047E+02	2.211E+05
2000	2.430E+05	3.888E+02	2.124E+05
2001	2.430E+05	3.736E+02	2.041E+05
2002	2.430E+05	3.589E+02	1.961E+05
2003	2.430E+05	3.449E+02	1.884E+05